

The opinion in support of the decision being entered today was not written for publication in a law journal and is not binding precedent of the Board.

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UNITED STATES PATENT AND TRADEMARK OFFICE

JUL 19 2005

U.S. PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ANDREW D. BAILEY III, ALAN M. SCHOEPP,
DAVID J. HEMKER and MARK H. WILCOXSON

Appeal No. 2005-1394
Application No. 09/440,794

ON BRIEF

Before KIMLIN, GARRIS and WARREN, Administrative Patent Judges.
KIMLIN, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 31-45 and 49-56. Claim 31 is illustrative:

31. A method for controlling processing uniformity while processing a substrate using a plasma-enhanced process, comprising:

providing a plasma processing chamber having a single chamber, substantially azimuthally symmetric configuration within which a plasma is both ignited and sustained during said processing of said substrate, said plasma processing chamber having no separate plasma generation chamber;

providing a coupling window disposed at an upper end of said plasma processing chamber;

providing an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

providing an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field at different radial locations above said substrate within said plasma processing chamber in the region proximate to said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect density of said plasma in said region proximate to said coupling window and antenna;

providing a dc power supply coupled to said electromagnet arrangement;

placing said substrate into said plasma processing chamber;

flowing reactant gases into said plasma processing chamber, said reactant gases include a combination of gases, wherein two or more gases of said combination of gases included in said reactant gases is a $C_x F_y H_z O_w$ gas;

striking said plasma out of said reactant gases;

changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate to said antenna to control said density of said plasma when said reactant gases are being flown in said plasma processing and thereby improving processing uniformity across said substrate; and

wherein said different radial locations include at least one radial region which is not in an axial direction perpendicular to said direction.

The examiner relies upon the following references as evidence of obviousness:

Lymberopoulos et al. (Lymberopoulos)	6,085,688	Jul. 11, 2000
Hills et al. Hills)	6,217,786 B1	Apr. 17, 2001
Kondo	6,254,966 B1	Jul. 3, 2001
Lu (European Patent Application)	0,821,397 A2	Jan. 28, 1998

Appellants' claimed invention is directed to plasma-enhanced processing of a substrate, such as etching, wherein process uniformity is controlled by affecting radial variation in a controlled magnetic field at different radial locations above the substrate. The radial variation in the field is effective to affect the density of the plasma.

The appealed claims stand rejected under 35 U.S.C. § 103(a) as follows:

- (a) claims 31-35 over Lymberopoulos in view of Hills;
- (b) claims 36-41 over the stated combination of references further in view of Kondo;
- (c) claims 42-45, 49-53 and 55 over the stated combination of references further in view of Lu.

Also, although the Examiner's Answer, at page 8, states a rejection of claim 31 under 35 U.S.C. § 112, first paragraph, the examiner goes on to state that appellants' arguments with respect

to this rejection "are persuasive" (page 11 of Answer, last sentence). Accordingly, we consider the § 112 rejection of claim 31 to have been withdrawn.

In accordance with the grouping of claims set forth at page 5 of appellants' principal brief, the following groups of claims stand or fall together: (I) claims 31-35, (II) claims 36-41, and (III) claims 42-45.

We have thoroughly reviewed each of appellants' arguments for patentability. However, we are in complete agreement with the examiner that the claimed subject matter would have been obvious to one of ordinary skill in the art within the meaning of § 103 in view of the applied prior art. Accordingly, we will sustain the examiner's rejections for the reasons set forth in the Answer, which we incorporate herein, and we add the following primarily for emphasis.

Lymberopoulos, like appellants, discloses a method and apparatus for plasma-enhanced processing of a substrate, such as dry etching, which includes the imposition of an electromagnetic field in the etching chamber. The principal argument advanced by appellants is that Lymberopoulos provides no teaching for a controlled magnetic field at different radial locations above the substrate. The examiner responds that Lymberopoulos expressly

discloses providing "independently controllable conductors for generating the magnetic field and to provide an adjustable non-uniformly distributed magnetic field within the chamber" (Abstract, penultimate sentence).

As recognized by the examiner, Lymberopoulos fails to specifically disclose the claimed "electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field at different radial locations above said substrate." However, it is well settled that when a claimed process reasonably appears to be substantially the same as a process disclosed by the prior art, the burden is on the applicant to prove that the prior art process does not necessarily or inherently possess characteristics attributed to the claimed process. In re Spada, 911 F.2d 705, 708, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990); In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). In the present case, we find that there is sufficiently close correspondence between the methods disclosed in appellants' specification to effect the claimed radial variation and the methods disclosed by Lymberopoulos to support the reasonable conclusion that the non-uniformly distributed magnetic field of the reference necessarily possesses the claimed radial variation. For instance, the specification

discloses that "the radially divergent magnetic field topology may be varied by changing the magnitude and/or direction of the dc current(s) that is/are supplied to the electromagnet coil(s)" (page 19 of specification, third paragraph). Likewise, Lymberopoulos teaches that the non-uniform magnetic field "is controlled by varying the current through conductors **150a & 150b**" (column 8, lines 11-12). Also, the reference teaches "a means to time vary the applied magnetic field, such as by pulsing zero to five gauss" (column 6, lines 24-26). Hence, it is reasonable to conclude that the changes in magnitude of current effected by the reference pulsing to generate a non-uniform magnetic field produces the claimed radial variation that appellants' specification teaches is brought about by a changing in the magnitude in the dc current.

Appellants' specification also discloses that "the radially varying magnetic field topology may also be varied by physically moving the upper magnet arrangement, either by rotating it about an axis different from 108, moving it along the chamber axis, moving it in the same plane and/or tilting the upper magnet arrangement" (id.). Similarly, Lymberopoulos teaches that another way of effecting a non-uniform magnetic field within the chamber is to have conductors 450a and 450b of different radius

or to have the conductors totally or partially in a nested or overlapping arrangement (see column 7, lines 51 et seq.) Again, we find that this close relationship between the disclosures in appellants' specification and in the reference provides the requisite evidentiary basis for reasonably concluding that the non-uniform magnetic field of the reference exhibits the radial variation presently claimed.

In our view, the burden has been properly shifted to appellants to proffer objective evidence which demonstrates that processes fairly disclosed by Lymberopoulos for producing non-uniform magnetic fields in a plasma-enhanced process do not necessarily or inherently result in the claimed radial variation in the magnetic field. However, no such evidence has been presented by appellants. While appellants emphasize that Lymberopoulos teaches that the magnetic field is oriented generally perpendicular to the wafer surface, appellants have not explained why the general perpendicular orientation of the field would necessarily preclude at least some radial variation in the field. Nor have appellants effectively refuted the examiner's argument based on the similarity in the magnetic fields depicted in reference Figure 11 and appellants' Figure 2A.

Appellants also maintain that Hills proposes to use a single fluorocarbon gas and, therefore, cannot possibly teach or suggest flowing two or more of the claimed gases (see page 11 of principal brief). However, as properly noted by the examiner, Hills expressly teaches that the fluorocarbon gas can be a mixture of the disclosed fluorocarbon compounds (see column 4, lines 57-59).

As for the separate rejections over the additional teachings of Kondo and Lu, we subscribe to the reasoning set forth in the Examiner's Answer.

As a final point, we note that appellants base no argument upon objective evidence of nonobviousness, such as unexpected results.

In conclusion, based on the foregoing and the reasons well-stated by the examiner, the examiner's decision rejecting the appealed claims is affirmed.

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv) (effective Sep. 13, 2004; 69 Fed. Reg. 49960 (Aug. 12, 2004); 1286 Off. Gaz. Pat. Office 21 (Sep. 7, 2004)).

AFFIRMED

Edward C. Kimlin

EDWARD C. KIMLIN)
Administrative Patent Judge)

Bradley R. Garris

BRADLEY R. GARRIS)
Administrative Patent Judge)

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Charles F. Warren

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